

The opinion in support of the decision being entered today was not written for publication and is not binding precedent of the Board.

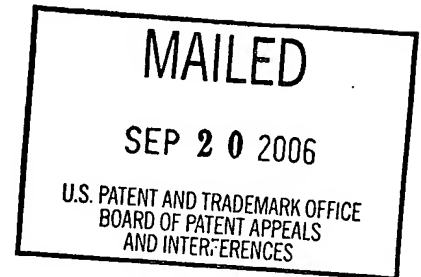
## UNITED STATES PATENT AND TRADEMARK OFFICE

### BEFORE THE BOARD OF PATENT APPEALS AND INTERFERENCES

Ex parte JAMES D.B. SMITH

Appeal No. 2006-2810  
Application No. 10/618,111

ON BRIEF



Before ADAMS, MILLS, and LEOVITZ, Administrative Patent Judges.

LEOVITZ, Administrative Patent Judge.

#### DECISION ON APPEAL

This appeal involves claims to alumoxane-LCT-epoxy resins and methods of preparing them. The examiner has rejected the claims as obvious over prior art. We have jurisdiction under 35 U.S.C. § 134. We affirm.

#### Background

Epoxy resins are used extensively in electrical insulators for their strength, chemical resistance, and electrical insulating properties. Specification, ¶ 3. Improvements have been made by mixing epoxy resins with liquid crystals to create liquid crystal thermoset (LCT) epoxy resins. Id., ¶ 5. LCT epoxy resins have superior

mechanical and thermal properties in comparison to non-LCT resins. Id., ¶ 5, 6. The improved thermal conductivity is advantageous because it increases the efficiency and durability of electrical components, particularly air-cooled components. Id., ¶ 4, 39.

The application describes LCT epoxy resins that incorporate carboxylate-alumoxane materials ("boehmite"<sup>1</sup>). Id., ¶ 9-11; Brief, page 1, section V. The resulting LCT resins have improved thermal conductivity values without appreciably reducing their electrical insulating properties. Id., ¶ 24, 39, 40. They are prepared by reacting the LCT-epoxy resin with carboxylate-alumoxane, and then adding a curing agent to harden the polymer. Id., ¶ 33.

### Discussion

#### Claim construction

Claims 1-19 are on appeal. There are three independent claims. Independent claims 1 and 12 are method claims; independent claim 15 is a composition claim. Because Appellant did not provide separate arguments for patentability, the claims stand or fall together. We will focus on claim 1, which reads as follows:

A method of making homogeneous alumoxane-LCT-epoxy polymers with a dielectric strength of at least 1.2 kV/mil and a thermal conductivity in the transverse direction of at least 0.50 W/mK and in the thickness direction of at least 0.99 W/mK in an environment of 25°C comprising:

mixing at least one LCT-epoxy resin with at least one boehmite material, under sufficient conditions to form a uniform dispersion and an essentially complete co-reactivity of said at least one boehmite material with said at least one LCT-epoxy resin, wherein a mixture is formed; and

curing said mixture to produce said homogeneous alumoxane-LCT-epoxy polymers;

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<sup>1</sup> "Boehmite refers to a nano-sized alumina material capable of being reacted with the LCT-epoxy resins." Specification, ¶ 44.

wherein the amount of said at least one boehmite material to said at least one LCT epoxy resin comprises a ratio of between 3:17 and 13:7 by weight.

Claim 1 is directed to a method of making an alumoxane-LCT epoxy polymer having specific dielectric strength and thermal conductivity properties. It has two steps. In the first step, the LCT epoxy resin is mixed with an alumoxane material (boehmite) to form a mixture in which the resin reacts “essentially” completely with the alumoxane. Specification, ¶ 33. The alumoxane becomes bonded to the LCT-epoxy resin. Id., ¶ 35. The mixture is cured (i.e., hardened) to form a polymer in the second step. Id., ¶ 33. This step involves cross-linking the LCT-epoxy/alumoxane monomers together to form a polymer of repeating units. Id., ¶ 34, 35. The ratio between the alumoxane and LCT-epoxy resin is claimed to be at a “ratio of between 3:17 and 13:7 by weight.”

Obviousness under 35 U.S.C § 103

Smith in view of Cook

Claims 1-9 and 11-19 stand rejected under 35 U.S.C. § 103 as unpatentable over Smith<sup>2</sup> in view of Cook<sup>3</sup>.

The Smith patent describes liquid crystal thermostat epoxy resins that can be used as electrical insulators on electrical conducting devices. Smith, Abstract. Epoxy resins are used extensively as electrical insulators for their “combination of toughness, flexibility, adhesion, chemical resistance and electrical properties.” Id., column 1, lines 10-12. “Liquid crystal polymers have been used to enhance the mechanical properties

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<sup>2</sup> Smith et al. (Smith), U.S. Pat. No. 5,904,984, issued May 18, 1999

<sup>3</sup> Cook et al. (Cook), U.S. Pat. No. 6,369,183, issued Apr. 9, 2002

of epoxy resins.” Id., column 1, lines 19-20. Smith discloses LCTs which are described as having “superior electrical and mechanical properties.” Id., column 2, lines 20-25. They also have better thermal properties. Id., column 7, lines 10-25. An LCT with a chemical formula I is described which contains a mesogen between terminal epoxy functional groups. Id., column 2, lines 30-34. The mesogen is selected from a list of 16 different R-groups ((a)-(p)). Id., column 2, lines 45. In preferred embodiments, the epoxy groups are crosslinked (“cured” or “hardened”) with an anhydride curing agent to form a hardened, densely packed material. Id., column 5, lines 20-31. The LCTs can be combined with other materials to improve the flexibility, electrical properties, and other characteristics of the resin. Id., column 6, lines 37-50.

Hybrid polymers containing chemically modified carboxylate-alumoxane as filler are described in the Cook patent. Cook, column 1, lines 14-17. The carboxylate-alumoxane is chemically bonded to the polymer backbone by the reaction of functional groups in the polymeric units with the carboxylate-alumoxane. Id., column 1, lines 17-21. The chemical modification is described as improving the properties of the polymers, including strength and flexibility. Id., column 1, lines 51-57; column 13, line 55; column 14, line 31; column 17, lines 38-54. Cook discloses hybrid polymers containing a thermoset epoxy resin chemically combined with carboxylate-alumoxane. Id., column 11-12. According to Cook, any commercially available epoxy resin can be utilized. Id., column 12, lines 11-17.

The examiner rejected claims 1-9 and 11-19 as being obvious over the combination of Smith and Cook. According to the examiner, it would have been obvious to the skilled worker at the time the invention was made to have applied Cook’s method

of forming hybrid resins to the LCT resin of Smith for its expected advantage in improving the resin's properties. Answer, page 4, last paragraph; page 6.

Appellant argued that there was no motivation to have combined the references. First, they contended that Cook was not enabling. Brief, page 4, paragraph i). Secondly, they stated that LCT resins were not "commercially available at the time of Cook." According to Appellant, commercial availability was a requirement of Cook. Id., page 5, paragraph ii). Finally, they argued that the combination of Smith and Cook would not result in the claimed invention. Id., page 5, paragraph iii). An affidavit was also provided to establish "unexpected results." Id., page 7.

The examiner bears the initial burden of showing unpatentability. See, e.g., In re Rijckaert, 9 F.3d 1531, 1532, 28 USPQ2d 1955, 1956 (Fed. Cir. 1993). In order to establish a case of prima facie obviousness, it must be shown that all elements of a claimed invention are found in the combination of prior art references and that the person of ordinary skill in the art would have been motivated with a reasonable expectation of success to have made the claimed composition or device, or carry out the claimed process. Velander v. Garner, 348 F.3d 1359, 1363, 68 USPQ.2d 1769, 1772 (Fed. Cir. 2003).

First, we address the issue of whether all elements of the claimed invention can be found in the prior art. On pages 3 and 5 of the Answer, the examiner identified where each of the claimed features are disclosed in the Smith and Cook patents. Our review of Smith and Cook, particularly the disclosures pointed to in the Answer, confirms the examiner's findings. Appellant did not point to any defect in the examiner's

argument. Consequently, we find that the examiner has satisfied this prong of the obviousness standard.

Next, we turn to the question of whether there was adequate motivation for the person of skill in the art to have combined the references. As pointed out by the examiner (Answer, page 5, lines 1-3), Cook explained that unfilled thermoset polymers are prone to structural defects.

In general, unfilled thermoset polymers tend to be harder, more brittle and not as tough as thermoplastic polymers. Thus, it is common practice to add a second phase (i.e., fillers) to thermosetting polymers to improve their properties. In addition, incorporation of fillers into the polymer matrices also strengthens and stiffens the polymer matrix allowing the polymers to be used in an expanded range of structural applications.

Cook, column 1, lines 52-59

To address this problem, Cook outlined a method of producing hybrid polymers containing a chemically modified carboxylate-alumoxane. This approach was described to improve the properties of the hybrid polymer as compared to the unmodified form. Cook suggests this approach, as noted by the examiner, for "a wide range of polymer matrices," including thermoset epoxy resins. Cook, column 6, lines 19-21; column 12, lines 11-17. The examples include DER 332 Epoxy resin (column 20, examples 16-20); HTR-212 (column 20, example 22); ERL 4221 (column 22, example 32); EP-REZ-5522-WY-55 (column 22, example 33). See also Cook, column 7, lines 8-19 which lists seven different classes of polymers.

A suggestion, teaching, or motivation to combine the relevant prior art teachings does not have to be found explicitly in the prior art. "[T]he teaching, motivation, or suggestion may be implicit from the prior art as a whole, rather than expressly stated in

the references. The test for an implicit showing is what the combined teachings, knowledge of one of ordinary skill in the art, and the nature of the problem to be solved as a whole would have suggested to those of ordinary skill in the art.” In re Kahn, 441 F.3d 977, 987-988, 78 USPQ2d 1329, 1336 (Fed. Cir. 2006). While Cook does not expressly state that carboxylate-alumoxane can be combined with LCTs, his message is clear: carboxylate-alumoxane fillers can be used to circumvent the structural problems observed with unfilled polymers. We view this as a strong motivational teaching, irrespective of the specific type of epoxy polymer.

Smith solidifies the motivation. On column 6, line 37-39, Smith states that “[f]urther embodiments of the invention are modified to lower costs and improve flexibility and other properties of LCT.” Cook explicitly suggests a modification (i.e., carboxylate-alumoxane) that improves brittleness (i.e., “flexibility”), a deficiency acknowledged in Smith. Cook, Id., column 1, lines 51-57; column 13, line 55-column 14, line 31; column 17, lines 38-54. Combined, we are in agreement with the examiner that the skilled worker would have been motivated to modify the Smith’s LCT resin with Cook’s teachings.

In setting forth the rejection, the examiner relied in part on Cook’s disclosures that its methods could be applied to “any commercially available epoxy resin.” The examiner asserted this suggested Smith’s LCT-epoxy resin. Appellant contended that Cook’s statement was not enabling. Brief, Page 4, paragraph i).

Such a broad, omnibus statement certainly can't be taken at face value. It cannot be enabling. Elan Pharm., Inc. v. Mayo Foundation for Medical and Education Research, 346 F.3d 1051, 1054, 68 USPQ2d 1373, 1376 (Fed. Cir. 2003), states that a reference must be enabling and that mere naming is insufficient if it cannot be produced without undue experimentation.

Id.

We do not find Appellants' argument persuasive. As pointed out by the examiner, the Elan case was referring to the requirements for anticipation, not obviousness. "To serve as an anticipating reference, the reference must enable that which it is asserted to anticipate." Elan, 346 F.3d at 1054, 68 USPQ2d at 1375. For obviousness, it is the combination of references which must "enable" the claimed subject matter. In this context, we are persuaded by the examiner's argument that applying the method taught by Cook to the LCT resin of Smith would enable one of ordinary skill in the art to produce a resin with the claimed properties. Appellant has not identified a deficiency in the cited prior art that would have resulted in failure.

It was also argued by Appellant that "LCT resins were not commercially available resins at the time of Cook." Brief, page 5, paragraph ii). Appellant has misidentified the relevant time frame for determining patentability. According to 35 U.S.C. § 103(a): "A patent may not be obtained though the invention is not identically disclosed or described as set forth in section 102 of this title, if the differences between the subject matter sought to be patented and the prior art are such that the subject matter as a whole would have been obvious at the time the invention was made to a person having ordinary skill in the art . . ." (emphasis added.) The question is more properly whether the resins were available on the application filing date, not "at the time of Cook." The



answer is undeniably affirmative since Smith's disclosure of LCT epoxy resins was available on Appellant's filing date.

It is our view that Appellant makes too much of Cook's statement that the method could be practiced on "any commercially available resin," improperly interpreting it as a limitation as to what polymers are reasonably suggested by the Cook disclosure. Brief, page 5. In the next sentence that follows this statement, Cook goes on to say:

To those skilled in the art, the reaction between any amine (primary or secondary) functionalized carboxylate-alumoxane or hydroxyl functionalized carboxylate-alumoxane and a resin containing an oxirane [epoxy] ring would lead to the formation of a carboxylate-alumoxane-epoxy polymer hybrid material.

Cook, column 12, lines 18-23.

As we understand it, Cook is stating that the reaction between a resin and carboxylate-alumoxane would be expected by the skilled worker to lead to a hybrid epoxy polymer material containing the alumoxane. Rather than expressing a reservation about the applicability of the method, Cook's message is matter-of-fact: put an epoxy resin together with alumoxane to get the hybrid epoxy polymer. There are at least four different epoxies utilized by Cook in the working examples. Cook, Examples 19, 22, 32, and 33. After considering the entirety of Cook's disclosure, we see no compelling reason to read "any commercially available resin" as a limitation to its teachings.

Moreover, as discussed above, the motivation to have utilized the Smith LCT epoxy polymer does not solely emanate from Cook's statement about commercial availability. Smith describes using fillers to improve the properties of its LCT resins. Smith, column 6, lines 37-50. As argued by the examiner, this statement combined with

Cook's description of the carboxylate-alumoxane also provides the necessary motivation. Answer, page 7, lines 9-16.

Obviousness requires motivation and an expectation of success. Appellant hammers at the "success" prong, arguing that combining Cook with Smith

would be expected to get a resin without a crystalline structure . . . A rather mundane analogy is that mixing milk and orange juice will be expected to get you spoiled milk. However, under certain conditions it can get you a creamsicle. Smith '984 teaches milk, Cook teaches orange juice, but the present invention teaches a creamsicle, and that is what is claimed.

Brief, page 5, paragraph iii).

Appellant's creamsicle example is illuminating, but leads us to the opposite conclusion. Smith in view of Cook provides not only the milk and orange juice, but also the recipe for making the creamsicle. Cook has numerous examples of making polymers which contain the carboxylate-alumoxane. See e.g., Cook, column 18-column 25. Thus, we find that the "certain conditions" are taught by the prior art. Appellant has not pointed to any feature or step in the claim that would distinguish it from the prior art methods.

Appellant also objected to the examiner's chemical diagrams as "impermissible hindsight reconstruction." Brief, paragraph spanning pages 5-6. We are not in agreement. The chemical diagrams on pages 10-14 of the Answer convincingly illustrate the structural similarity between the epoxy resin utilized in the Cook patent (Fig. 10) and the liquid crystal thermoset epoxy resins in Smith. We are persuaded by the examiner's argument that Cook inadvertently omitted an oxygen atom in Fig. 10. Brief, page 10, lines 5-7; Reply brief, page 3. Appellant has not told us how the examiner is wrong, only that his "assumption is improper." Id. In our view, the examiner

correctly observed that the skilled worker would have recognized that the chemical reaction is atomically unbalanced and would have known how to correct it.

Appellant also challenged the examiner's conclusions: 1) that it would have been obvious to have substituted a structurally similar compound into Cook; and 2) that because of the structural similarities, it would be expected to work. Answer, page 14; Brief page 14,

We agree with the examiner that there is a sufficiently close structural relationship between Cook's compound and Smith's LCT epoxy to reasonably expect that it could be substituted with carboxylate-alumoxane and produce a functional composite polymer. See In re Dillon, 919 F.2d 688, 16 USPQ2d 1897 (Fed. Cir. 1990) (en banc). We make this conclusion irrespective of the propriety of the examiner's "flowing" chemical diagrams. Brief, page 5, last line. Appellant eluded to a showing of "no reasonable expectation of success of similar properties," but other than conclusory statements that mesogens would be expected to alter the properties of Cook's epoxies, we find no evidence of record to substantiate their position. Reply brief, page 2.

Appellant maintained that there would be no expectation that a liquid crystal structure would result from the application of Cook's method to Smith's LCT epoxy resin. Brief, page 6, lines 11-12. However, we do not see any evidence in the record that would lead to this conclusion. To begin with, it is not clear to us that the claimed subject matter actually requires that the material have a crystalline structure as repeatedly argued in the Brief. See e.g., Brief, page 1, V. Notwithstanding, as already pointed out, Smith expressly states that LCTs can be combined with other materials to improve their properties. Smith, column 6, lines 30-40. This would have led the skilled

worker to expect that LCTs could be modified without deleteriously affecting their structure, but instead improving it. In light of this, we do not find Appellant's conclusory statements credible that the addition of fillers would be expected to "ruin" the LCT structure. Brief, page 6.

In sum, we conclude that the examiner has provided adequate evidence to establish a case of prima facie obviousness.

A declaration was proffered by Appellant to establish unexpected results. Declaration of James D. Smith under 37 CFR § 1.132 (hereinafter, the "Smith Declaration"). "An applicant may rebut a prima facie case of obviousness by providing a 'showing of facts supporting the opposite conclusion.' Such a showing dissipates the prima facie holding and requires the examiner to 'consider all of the evidence anew.' Rebuttal evidence may show, for example, that the claimed invention achieved unexpected results relative to the prior art." In re Kumar, 418 F.3d 1361, 1368, 76 USPQ2d 1048, 1052 (Fed. Cir. 2005) (internal citations omitted). "[I]t is well settled that unexpected results must be established by factual evidence. 'Mere argument or conclusory statements in the specification does not suffice.' In re De Blauwe, 736 F.2d 699, 705, 222 USPQ 191, 196 (Fed. Cir. 1994); see also In re Soni, 54 F.3d at 750, 34 USPQ2d at 1687." In re Geisler, 815 F.2d 686, 1365, 43 USPQ2d 1362, 1365 (Fed. Cir. 1997). The Board has "broad discretion as to the weight to give declarations offered in the course of prosecution." In re American Academy of Science Tech Center, 367 F.3d 1359, 70 USPQ2d 1827 (Fed. Cir. 2004).

We find ourselves in agreement with the examiner that the Smith declaration does not provide adequate evidence to rebut the case of prima facie obviousness.

In his declaration, Smith states that it was “unexpected” that LCT resins “could be used in any manner as enhanced thermally conductive resins.” Smith Declaration, ¶4. However, he did not provide any factual evidence to explain how he arrived at this conclusion. We find this information necessary to properly weigh the evidence. For example, the specification compares the thermal conductivity of a non-liquid crystal epoxy resin to an alumoxane-LCT-epoxy anhydride<sup>4</sup>. Specification, page 11, ¶41. To establish unexpected results, the claimed subject matter must be compared with the closest prior art. In re Burckel, 592 F.2d 1175, 201 USPQ 67 (CCPA 1979). It was not established that a non-LCT epoxy resin is the closest prior art, e.g., closer than the LCT epoxy resin disclosed in the Smith patent. Thus, we cannot accept Smith’s statement without knowing the facts upon which he derived his opinion.

Additionally, in his statement concerning the combination of LCTs with other agents to produce a resin having the claimed thermal conductivity, Smith simply observes that it “very interesting” to have obtained a material with these properties. Smith Declaration, ¶4. “[W]hen an applicant demonstrates substantially improved results ... and states that the results were unexpected, this should suffice to establish unexpected results in the absence of evidence to the contrary.” In re Soni, 54 F.3d 746, 751 34 USPQ2d 1684, 1688 (Fed. Cir. 1995). We find no evidence of unexpected results nor even a statement by the declarant that such results were “unexpected.” Just “interesting” results do not suffice.

Along these same lines, Smith mentions experiments using fillers such as alumina and silica, but does not present any data to substantiate his conclusion that

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<sup>4</sup> Appellant did not point to this disclosure in the Brief.

these fillers were deleterious to the LCT epoxy resin structure. Thus, these results are also not persuasive.

In ¶7 of the Smith Declaration, it was stated:

By mixing the alumoxanes of Cook '183 with the LCT of Smith '984 one would expect to get, and would in all likelihood end up with, a ruined LCT resin that has disrupted crystalline domains and phase separation with the added alumoxanes.

This statement, as pointed out by the examiner, is confusing. Answer, pages 15-16. If "in all likelihood" Cook in view of Smith would "end up with, ruined LCT resin," then what is Appellant doing differently to avoid this result, and how is this reflected in the claims? Although this issue was raised in the Answer, we do not find it adequately addressed in the Brief or Reply brief.

Appellant also contends that the examiner acquiesced to their position:

In any event, perplexingly enough, the Examiner actually agrees with the assertion that "mixing of particles likely would have disrupted the crystalline structure of the LCT-resin," but he goes one to state that "this appears to be moot in light of the combined teachings." (Page 9 of advisory action, middle paragraph.) So the Examiner is stating that obtaining a ruined resin is sufficient prior art, due to the structural similarities that he demonstrated, to overcome the crystalline resin of applicant's invention.

Brief, page 6.

Cook's method does not involve only mixing of "particles" with epoxy resins, but also requires the chemical bonding of the alumoxane material with the epoxy polymer. Whether unbound particles would disrupt the crystalline structure was considered "moot" by the examiner, because Cook's method used a different approach. Thus, we do not view the examiner's statement to be a concession that Appellant is correct in their position.

Stackhouse

Claim 10 stands rejected under 35 U.S.C. § 103 as unpatentable over Smith in view of Cook as applied to claims 1-9 and 11-19, and further in view of Stackhouse<sup>5</sup>.

Upon consideration of the record before us, we find no error in the combination of Smith, Cook, and Stackhouse. For his part, Appellant focused attention on Smith and Cook and did not address Stackhouse. For the foregoing reasons, we find no deficiency in Smith and Cook. Since Appellant did not address Stackhouse or its combination with Smith and Cook (Brief, page 8), we are compelled to affirm this rejection.

Summary

The rejection of claims 1-19 as obvious over prior art is affirmed.

AFFIRMED



Donald E. Adams  
Administrative Patent Judge



Demetra J. Mills  
Administrative Patent Judge



Richard M. Lebovitz  
Administrative Patent Judge

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<sup>5</sup> Stackhouse et al. (Stackhouse), U.S. Pat. No. 4,427,740, issued Jan. 24, 1984

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